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EXAMINER	
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/076,915	TONKOVICH ET AL.	
	Examiner	Art Unit	
	JENNIFER A. LEUNG	1797	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *11/19/07, 12/21/07, 12/31/07, 3/22/08*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-30 and 75-101* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) *5 and 98* is/are allowed.

6)☒ Claim(s) *1-4,6-30,75-81,85-97 and 99-101* is/are rejected.

7)☒ Claim(s) *82-84* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *3-22-08*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on November 19, 2007 has been entered.

Status of the Claims

2. Claims 31-74 are cancelled. Claim 101 is new. Claims 1-30 and 75-101 are active.

Claim Objections

3. Claims 1, 9-12, 16, 75, 76, 78, 81, 84, 86, 89 and 95 are objected to because:

In claim 1, lines 16-20: The limitation appears to contain redundancy. The Examiner suggests changing the limitation to read as: "wherein the at least one flow path in which there is a straight unobstructed line in said at least 3 shims is defined by borders of apertures in said at least 3 shims, ~~and wherein, in each of said borders of apertures in said at least 3 shims defining a flow path,~~ wherein each of said borders has a circumference and wherein said circumference in each shim is at least 20% populated by edge features;".

In claim 9, lines 2 and 3: "the flow path" should be changed to --the at least one flow path--.

In claim 10,

lines 2-3: The limitation should be corrected as follows: "a continuous first flow path, ~~and~~ a continuous second flow path and a continuous third flow path";

line 4: The limitation should be corrected as follows: "the first, ~~and~~ second and third";

lines 12-13: The limitation should be corrected as follows: "the first flow path, ~~and~~the second flow path and the third flow path".

In claim 11, lines 1-4: The limitation appears to contain redundancy. The Examiner suggests changing the limitation to read as: "wherein the first flow path formed in said at least 3 shims is defined by borders of apertures in said at least 3 shims, ~~and wherein, in each of said at least 3 shims there is a border of said borders of apertures in said at least 3 shims defining the first flow path,~~ the borders having a circumference."

In claim 12, lines 1-4: The limitation appears to contain redundancy. The Examiner suggests changing the limitation to read as: "wherein the first flow path formed in said at least 3 shims is defined by the borders of apertures in said at least 3 shims, ~~and wherein, in at least one of said at least 3 shims there is a border of said borders of apertures in said at least 3 shims defining the flow path,~~ the borders having a circumference."

In claim 16, lines 1-2: It is suggested that the limitation be changed to read as a process step: "further comprising passing a second fluid ~~that passes~~ through a second flow path."

In claim 75, line 1: "the flow path" should be changed to --the at least one flow path--.

In claims 76, lines 1-3: The claim is objected to under 37 CFR 1.75(c) as being of improper dependent form for failing to further limit the subject matter of a previous claim. It is noted that the Markush group in claim 76 is broader than the Markush group in claim 13, lines 19-21.

In claim 78, line 1: "the flow path" should be changed to --the at least one flow path--.

In claim 81, line 2: "said flow" should be changed to --said first flow path--.

In claim 84, line 1: "the flow path" should be changed to --the second flow path--, since

reacting only occurs in the second flow path.

In claim 86, line 1: "the flow path" should be changed to --the at least one flow path--.

In claim 89, line 2: "that" should be deleted, for proper grammatical form.

In claim 95, line 2: --at least one-- should be inserted before "flow path".

Appropriate correction is required.

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

4. Claims 6, 7, 10-12, 30, 79-81, 86, 94 and 101 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Regarding claims 6 and 7, "the *first* flow path" and "said *first* flow path" each lack proper positive antecedent basis. Also, it is unclear as to how the first flow path "does not connect with any other flow paths", since it is noted that the flow paths are all connected by "a common header" that is recited in claim 1, line 6. Claim 79 is rejected for being dependent from claim 6.

Regarding claim 10, it is unclear as to the structural limitation applicant is attempting to recite by, "the first flow path, second flow path, and third flow path are each in alternating parallel rows wherein the second flow path is disposed between the first and third flow paths," in lines 37-38. The term "alternating" implies a pattern involving two elements; however, the instant claim recites three elements (i.e., three flow paths). It appears that applicant is attempting to recite that the first flow path, the second flow path, and the third flow path are disposed "in a sequence" of parallel rows, wherein the second flow path is disposed between the first and third

flow paths. Claims 11, 12 and 101 are similarly rejected for being dependent from claim 10.

Regarding claim 30, it is unclear as to how the second unit operation can further comprise an endothermic reaction, since claim 29 sets forth that the second unit operation comprises an exothermic reaction.

Regarding claim 80, it is unclear as to how the first flow path can contain a catalyst (which indicates reacting), since claim 27, lines 16-18, now sets forth that the first unit operation conducted in the first flow path *does not* include reacting.

Regarding claim 81, it is unclear as to how an exothermic reaction can be conducted in the first flow path since claim 27, lines 16-18, now sets forth that the first unit operation conducted in the first flow path *does not* include reacting.

Regarding claim 86, it is unclear as to how the flow path "does not connect with any other flow paths", since it is noted that the flow paths are all connected together by "a common header" that is recited in claim 1, line 6.

Regarding claim 94, it is unclear as to how "the at least one flow path… does not connect with any other flow paths", since it is noted that the flow paths are all connected by "a common header" that is recited in claim 1, line 6.

Claim Rejections - 35 USC § 102 and § 103

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all

obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 1-4, 6-9, 75, 78, 79, 86, 94 and 95

5. Claims 1-3, 6-9, 75, 78, 79, 86, 94 and 95 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bottcher et al. (US 5,657,818) in view of Yamashita (JP 2000-329490).

Regarding claims 1, 8 and 9, Bottcher et al. (see FIGs. 1-5; column 1, line 50 to column 2, line 49) discloses process of making a device (i.e., a permeable structure) for conducting a unit operation comprising:

stacking a plurality of shims (i.e., sheets **2**) such that a plurality of continuous flow paths are formed through the shims (e.g., continuous channels **1**, formed by aligned openings **7**); wherein the plurality of continuous flow paths **1** extend in a direction substantially parallel to shim **2** thickness (see FIGs. 1, 2); wherein the plurality of continuous flow paths **1** are connected to a common header (see, e.g., column 2, lines 9-16); wherein the plurality of shims comprises at least three adjacent shims **2** (see column 1, lines 31-35) through which the flow path **1** is formed and wherein a straight, unobstructed line is

present through the flow path **1** in said at least three shims **2** (see, e.g., FIGs. 1, 2); wherein the flow paths **1** are defined by the borders of the aligned apertures **7** in said at least three shims **2**; wherein the three shims are configured such that a unit operation can be performed on a fluid in the flow path in which the straight, unobstructed line is present in said at least three adjacent shims (e.g., heat exchanging, condensing, reacting, etc. with fluids; see column 2, lines 49-55); and

bonding the shims to form the device capable of performing the unit operation on a fluid (see column 2, lines 32-36).

The process of making as disclosed by Bottcher et al. is the same as the instantly claimed process, but Bottcher et al. is silent as to the borders of apertures **7** having a circumference at least 20% populated by edge features.

Yamashita et al. (see FIGs. 2, 3) teaches a process of making a device by stacking a plurality of shims (i.e., plates **11(1)**, **11(2)**… **11(n)**; or plates **21(1)**, **21(2)**… **21(n)**), wherein a continuous flow path extends in a direction substantially parallel to the shim thickness, and, in particular, the continuous flow path is defined by the borders of apertures **12b**, **22b**, said borders having a circumference at least 20% populated by edge features (i.e., a saw tooth configuration or a wave configuration toothing). (see also sections [0012]-[0013]) and claim 7).

It would have been obvious for one of ordinary skill in the art at the time the invention was made to configure the apertures in the process of Bottcher et al. with a circumference at least 20% populated by edge features, because the edge features increase the surface area of the continuous pathway, and thereby increases heat transfer within the device, as taught by Yamashita et al. (see, e.g., section [0012]).

Regarding claims 2 and 78, Bottcher et al. discloses that the aperture **7** comprises a shape selected from the group consisting of circles, ovals, irregular shapes, and rectangles with rounded corners (see FIGs. 1-5). In any event, the recitation of a specific shape does not confer patentability to the claim, since changes in shape involves only ordinary skill in the art. *In re Dailey* 149 USPQ 47, 50 (CCPA 1966); *Glue Co. v Upton* 97 US 3, 24 (USSC 1878).

Regarding claim 3, Bottcher et al. discloses that the aperture **7** in each of the at least three adjacent shims **2** may comprise a circle (see, e.g., FIGs. 3, 5), wherein the shims **2** are bonded to form the device (see column 2, lines 33-37) comprising a flow path having a cylindrical shape.

Regarding claims 6 and 94, Bottcher et al. discloses that the at least one flow path **1** may be configured such that it does not connect with any other flow paths (see, e.g., FIGs. 1, 2, wherein the flow paths **1** are separate from one another, and pass from a corresponding opening **9** in the top cover plate **5** to a corresponding opening **9** in the bottom cover plate **5**).

Regarding claims 7 and 79, Bottcher et al. further discloses that the centers of the apertures **7** may be offset from the common axis of the row of holes, such that structures can be built up in which the channels formed by the holes obtain a stepped or helical surface, thereby, inherently, defining a static mixer within the flow path (see column 1, lines 36-41 and 63-64).

Regarding claim 75, Bottcher et al. discloses that the flow path **1** is formed by an aperture **7** in each of the at least three adjacent shims **2**, wherein the shape may comprise an irregular shape (see, e.g., holes **7a** in FIG. 3). In any event, the recitation of a specific shape for the apertures does not confer patentability to the claim, since it has been held that changes in shape involves only ordinary skill in the art. *In re Dailey* 149 USPQ 47, 50 (CCPA 1966); *Glue Co. v Upton* 97 US 3, 24 (USSC 1878).

Regarding claim 86, Bottcher et al. discloses that the at least one flow path **1** may be configured such that it does not connect with any other flow paths (see, e.g., FIGs. 1, 2, wherein the flow paths **1** are separate from one another, and pass from a corresponding opening **9** in the top cover plate **5** to a corresponding opening **9** in the bottom cover plate **5**).

Regarding claim 95, Yamashita et al. (FIGs. 2, 3; sections [0012]-[0013]) and claim 7) further teaches that the borders of the apertures **12b**, **22b** is at least 50% populated by edge features (i.e., a saw tooth configuration or a wave configuration toothing). Although Yamashita et al. is silent as to whether the edge features cause at least a 1% variation in the diameter of the aperture, the specific percentage of diameter variation is not considered to confer patentability to the claim since the precise percentage would have been considered a result effective variable by one having ordinary skill in the art. Accordingly, one having ordinary skill in the art would have routinely optimized the amount of diameter variation caused by the edge features in the modified process of Bottcher et al. to obtain the desired level of heat transfer efficiency within the device. *In re Boesch*, 617 F.2d. 272, 205 USPQ 215 (CCPA 1980), and since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233.

6. Claim 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over Bottcher et al. (US 5,657,818) in view of Yamashita (JP 2000-329490), as applied to claim 1 above, and further in view of Bottcher et al. (US 5,212,004).

Bottcher et al. '818 discloses that the at least 3 adjacent shims may comprise "different sheet patterns." (see column 1, lines 31-35). Bottcher et al. '818, however, is silent as to the at least 3 adjacent shims being identical. Bottcher et al. '004, however, teaches that a continuous

flow path may be formed by stacking 3 adjacent shims that are identical (see column 2, lines 56-62). It would have been an obvious design choice for one of ordinary skill in the art at the time the invention was made to configure the at least 3 adjacent shims to be identical in the process of Bottcher et al. '818, in order to allow for the surface ratio of the various flow paths to be varied and thus adapted to meet a particular heat transfer requirement, as taught by Bottcher et al. '004.

Claims 10-12 and 101

7. Claims 10 and 101 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bottcher et al. (US 5,657,818).

Bottcher et al. (see FIG. 2) discloses a process comprising:

stacking a plurality of shims (i.e., sheets **2**) such that a continuous first flow path (i.e., a channel **1** formed by aligned openings **7** in a first row **3**), a continuous second flow path (i.e., a channel defined by aligned flow spaces **4**, between two successive rows **3**), and a continuous third flow path (i.e., a channel **1** formed by aligned openings **7** in a row **3** adjacent to the first row **3**) are formed through the shims; wherein the first, second and third flow paths are substantially parallel to the shim thickness (see FIG. 2; the paths **1** are parallel to the shim **2** thickness; also, the paths **4** are parallel to the shim **2** thickness in the regions between transverse bridges **6**); wherein the plurality of shims **2** comprise at least three shims through which the first, second and third flow paths are formed, and wherein a straight, unobstructed line is present through the first flow path **1** and the second flow path **4** in the at least three shims (see FIG. 2); wherein the first flow path **1** and the second flow path **4** each do not mix with any other flow paths (see FIG. 2);

bonding the shims **2** to form a device capable of performing a unit operation on a fluid (see

column 2, lines 33-55);

passing a first fluid into the device such that the fluid passes through the first flow path **1** and the third flow path **1** in said plurality of shims (i.e., via appropriate connections of neighboring rows **3** of channels **1**; see column 2, lines 10-15);

performing at least one first unit operation on the fluid as it passes through the first flow path **1** and the third flow path **1** (see column 2, lines 50-55);

passing a second fluid into the device such that the fluid passes through the second flow path **4** in said plurality of shims **2**;

performing at least one second unit operation of the fluid as it passes through the second flow path **4** (see column 2, lines 50-55);

wherein the first flow path **1**, the second flow path **4**, and the third flow path **1** are each in parallel rows, configured such that the second flow path **4** is disposed between the first and third flow paths **1** (see FIG. 2); and wherein each row comprises plural parallel flow paths **1** or **4** (see FIG. 2)

Bottcher et al. discloses that for the unit operations, the device may comprise "heat exchangers, condensers, part-condensers, coolers, reactors, heat exchangers for heaters, especially condensing heaters and waste heat boilers for heat exchange in gas/gas, gas/liquid or liquid/liquid systems, and for burner designs with gaseous or liquid fuels." (see column 2, lines 49-55). Thus, the first unit operation being conducted within the first and third flow paths **1** and the second unit operation being conducted within the second flow path **4** may be different, wherein, e.g., in the case of a waste heat boiler, a first unit operation may comprise vaporizing (i.e., boiling) and a second unit operation may comprise cooling (i.e., the waste heat is cooled

when heat is given up to the liquid being boiled). Also, e.g., in the case of a condensing heater, a first unit operation may comprise condensing and a second unit operation may comprise heating. The selection of an appropriate unit operation, from the list of various unit operations disclosed by Bottcher et al., for each of the flow paths would have been considered routine for one having ordinary skill in art.

8. Claims 11 and 12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bottcher et al. (US 5,657,818) in view of Yamashita et al. (JP 2000-329490).

Regarding claim 11, Bottcher et al. is silent as to the borders of apertures **7** having a circumference at least 20% populated by edge features. Yamashita et al. (see FIGs. 2, 3) teaches a process of making a device by stacking a plurality of shims (i.e., plates **11(1)**, **11(2)**... **11(n)**; or plates **21(1)**, **21(2)**... **21(n)**), wherein a continuous flow path extends in a direction substantially parallel to the shim thickness, and, in particular, the continuous flow path is defined by the borders of apertures **12b**, **22b**, said borders having a circumference at least 20% populated by edge features (i.e., a saw tooth configuration or a wave configuration toothing). (see also sections [0012]-[0013]) and claim 7). It would have been obvious for one of ordinary skill in the art at the time the invention was made to configure the apertures in the process of Bottcher et al. with a circumference at least 20% populated by edge features, because the edge features increase the surface area of the continuous pathway, and thereby increases heat transfer within the device, as taught by Yamashita et al. (see, e.g., section [0012]).

Regarding claim 12, Yamashita et al. further teaches that borders of the apertures in at least one of said shims comprises a circumference that is at least 20% populated by edge features (i.e., inner circumference of an opening **12b** comprising a saw tooth, FIG. 2; inner circumference

of an opening **22b** comprising a wave configuration toothing, FIG. 3; see also sections [0012]-[0013]) and claim 7), and a smooth border in another of said shims (i.e., inner circumference of an opening **12a**, FIG. 2; inner circumference of an opening **22a**, FIG. 3). It would have been obvious for one of ordinary skill in the art at the time the invention was made to configure the apertures in the process of Bottcher et al. to comprise at least 20% edge features, or a smooth border, on the basis of suitability for the intended use, in order to the desired amount of surface area within the continuous pathway to vary the heat transfer efficiency of the device, as taught by Yamashita et al. (see, e.g., section [0012]).

Claims 13-23, 76, 85, 96, 99 and 100

9. Claims 13-17, 21, 23, 76, 85, 96, 99 and 100 rejected under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Bottcher et al. (US 5,657,818).

Regarding claims 13, 14, 76, 85 and 100, Bottcher et al. (see FIGs. 1-5; column 1, line 50 to column 2, line 49) discloses a process comprising:

stacking a plurality of shims (i.e., sheets **2**) such that a continuous flow path is formed through the shims (e.g., continuous channels **1**, formed by aligned openings **7**); wherein the flow path **1** extends in a direction substantially parallel to shim **2** thickness (see FIGs. 1, 2); wherein the plurality of shims comprises at least three, or at least five, adjacent shims **2** (see column 1, lines 31-35) through which the flow path **1** is formed and wherein a straight, unobstructed line is present through the flow path **1** in said at least three shims **2** (see, e.g., FIGs. 1, 2);

bonding the shims (see column 2, lines 32-36) to form the device capable of performing the unit

operation (see column 2, lines 49-55) on a fluid;

passing the fluid into the device (i.e., via openings **9** in the cover plate 5) such that the fluid passes through the flow path **1** in said shims; and

performing the unit operation on the fluid as it passes through the flow path **1**.

Bottcher et al. further discloses that the device may be used to perform a variety of unit operations, since the device may be used as "heat exchangers, condensers, part-condensers, coolers, reactors, heat exchangers for heaters, especially condensing heaters and waste heat boilers for heat exchange in gas/gas, gas/liquid or liquid/liquid systems, and for burner designs with gaseous or liquid fuels." (see column 2, lines 50-55). The term "distillation" is defined as the volatilization or evaporation and subsequent condensation of a liquid, e.g., as when water is boiled in a retort and the steam is condensed in a cool receiver. Because the device is disclosed as having specific utility for the volatilization or evaporation of a liquid and condensation of a liquid (e.g., as a boiler, condenser, part-condenser, or condensing heater), it would have been obvious for one of ordinary skill in the art at the time the invention was made to perform the unit operation of distilling using the device of Bottcher et al., if not already inherent therein.

Regarding claim 15, Bottcher et al. discloses that the flow path may be configured such that it does not connect with any other flow paths (see, e.g., FIGs. 1, 2, wherein the flow paths **1** are separate from one another, and pass from a corresponding opening **9** in the top cover plate **5** to a corresponding opening **9** in the bottom cover plate **5**).

Regarding claims 16 and 17, Botcher et al. discloses that a second fluid may pass through a second flow path (e.g., defined by flow spaces **4**) in said at least three shims, wherein the fluid in the flow path **1** and the fluid in the second flow path **4** do not mix. As shown in FIG. 2, for

example, the second flow path **4** is substantially parallel to the shim thickness.

Regarding claim 21, the fluid in the second flow path **4** may comprise a heat exchange fluid (see column 2, lines 49-55; column 1, lines 56-60).

Regarding claim 23, the device may be used for performing the unit operations of reacting, or for burning gaseous or liquid fuels (see column 2, lines 49-55). Burning comprises an exothermic reaction. Thus, it would have been an obvious design choice for one of ordinary skill in the art at the time the invention was made to configure the second composition to comprise a reaction composition (e.g., a gaseous or liquid fuel) such that the reaction composition reacts exothermically (e.g., by burning), as specifically suggested by Bottcher et al.

Regarding claim 96, Bottcher et al. further discloses that the flow path **1** may be configured such that it does not connect with any other flow paths (see, e.g., FIGs. 1, 2, wherein the flow paths **1** are separate from one another, and pass from a corresponding opening **9** in the top cover plate **5** to a corresponding opening **9** in the bottom cover plate **5**).

Regarding claim 99, Bottcher et al. discloses at least five adjacent shims (see column 1, lines 31-35).

10. Claims 18-20 and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bottcher et al. (US 5,657,818) in view of Bottcher et al. (US 5,212,004).

Regarding claims 18-20, Bottcher et al. '818 disclose that the fluid the flow path **1** and the fluid in the second flow path **4** are separated, and the flow path **1** has rounded edges (see, e.g., FIGs. 1, 2). Bottcher et al. '818, however, is silent as to the flow paths **1** and **4** being separated by a distance of 5 mm or less, or 1 mm or less. In any event, it would have been obvious for one of ordinary skill in the art at the time the invention was made to configure the

distance according to the claimed range in the process of Bottcher et al. '818, on the basis of suitability for the intended use and absent a showing of unexpected results thereof, because the claimed distances would have been considered conventional for providing a suitable heat transfer distance, as suggested by Bottcher et al. '004 (see, e.g., column 2, lines 5-37). In addition, it would have been obvious for one of ordinary skill in the art at the time the invention to select an appropriate pressure difference of the fluids in the first flow and the second flow path in the process of Bottcher et al. '818, on the basis of suitability for the intended use and absent showing any unexpected results thereof, because it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art, *In re Aller, 105 USPQ 233*.

Regarding claim 22, Bottcher '818 further discloses that the first flow path may comprise first supports that extend across the flow path, and the second flow path may comprise second supports that extend across the second flow path, wherein the first and second supports are staggered (see column 1, lines 38-41 and 63-64; also, column 2, lines 5-8).

Claims 24-26, 77 and 97

11. Claims 24-26, 77 and 97 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bottcher et al. (US 5,657,818) in view of Haswell et al. (Article: *Chemical and biochemical microreactors*).

Regarding claims 24 and 26, Bottcher et al. (see FIGs. 1-5; column 1, line 50 to column 2, line 49) discloses a process comprising:

stacking a plurality of shims (i.e., sheets **2**) such that a continuous flow path is formed through the shims (e.g., continuous channels **1**, formed by aligned openings **7**); wherein the flow

path **1** extends in a direction substantially parallel to shim **2** thickness (see FIGs. 1, 2); wherein the plurality of shims comprises at least three shims **2** (see column 1, lines 31-35) through which the flow path **1** is formed;

bonding the shims (see column 2, lines 32-36) to form the device capable of performing a unit operation (see column 2, lines 49-55) on a fluid;

passing the fluid into the device (i.e., via openings **9** in the cover plate 5) such that the fluid passes through the flow path **1** in said shims; and

performing the unit operation on the fluid as it passes through the flow path **1** in which a straight, unobstructed line is present through the flow path **1** in said at least three shims **2** (see, e.g., FIGs. 1, 2).

Bottcher et al. is silent as to whether the flow path **1** may comprise a microchannel, such that the minimum dimension of the flow path is at least 10 μm, and the maximum dimension of the flow path is at most 1000 μm.

Haswell et al., however, teaches the known use of flow paths configured as microchannels for performing chemical and biochemical reactions, with the flow paths having dimensions within the instantly claimed ranges (e.g., 500 μm, page 391, last line in column 1; 700 μm, page 392, column 1; 300 μm wide and 115 μm deep, page 393, column 1).

It would have been obvious for one of ordinary skill in the art at the time the invention was made to configure the continuous flow path in the process of Bottcher et al. with microchannel dimensions, because the microchannel dimensions enables rapid mass and heat transfer to be achieved within the device, thereby providing a higher level of reaction control and reaction manipulation, as taught by Haswell et al. (see page 389, column 2). Furthermore, it has

been held that changes in size involve only ordinary skill in the art. *In re Rose*, 220 F.2d 459, 463, 105 USPQ 237, 240 (CCPA 1955).

Regarding claims 25, 77 and 97, Bottcher et al. discloses that the unit operation is selected from the group consisting of chemical reaction, vaporization, compression, chemical separation, distillation and condensation (see column 2, lines 49-55).

Claims 27-30

12. Claim 27-30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bottcher et al. (US 5,657,818).

Regarding claims 27-30, Bottcher et al. discloses a process comprising:

stacking a plurality of shims **2** such that a continuous first flow path (i.e., a channel **1**, defined by aligned openings **7**) and a continuous second flow path (i.e., defined by aligned flow spaces **4**) are formed through the shims; wherein the first and second flow paths are substantially parallel to the shim thickness (see FIG. 2; the paths **1** are parallel to the shim **2** thickness; also, the paths **4** are parallel to the shim **2** thickness in the regions between transverse bridges **6**); wherein the plurality of shims **2** include at least three shims through which the first flow path **1** is formed, and wherein a straight line can be drawn through the flow path in said at least three shims;

bonding the shims **2** to form a device capable of performing a unit operation on a fluid (see column 2, lines 33-55);

passing a first fluid into the device such that the fluid passes through the first flow path **1** in the plurality of shims **2**;

performing at least one unit operation on the fluid as it passes through the first flow path in said

plurality of shims **2** (see column 2, lines 49-55);

passing a second fluid into the device such that the fluid passes through the second flow path **4** in said plurality of shims **2**;

performing at least one second unit operation on the fluid as it passes through the second flow path **4** in said plurality of shims **2** (see column 2, lines 49-55).

Bottcher et al. discloses that the device may be used to perform a variety of unit operations, since the device may be used as "heat exchangers, condensers, part-condensers, coolers, reactors, heat exchangers for heaters, especially condensing heaters and waste heat boilers for heat exchange in gas/gas, gas/liquid or liquid/liquid systems, and for burner designs with gaseous or liquid fuels." (see column 2, lines 50-55). In the case of a burner design, the burning of fuels would be considered an exothermic reaction. In the case of a reactor, the selection of an exothermic reaction or an endothermic reaction would have been considered a conventional design consideration for one having ordinary skill in the art. Also, "distillation" is defined as the volatilization or evaporation and subsequent condensation of a liquid, e.g., as when water is boiled in a retort and the steam is condensed in a cool receiver. Because the device is disclosed as having specific utility for the volatilization or evaporation of a liquid and condensation of a liquid (e.g., as a boiler, condenser, part-condenser, or condensing heater), it would have been obvious for one of ordinary skill in the art at the time the invention was made to perform the unit operation of distilling using the device of Bottcher et al., if not already inherent therein. The selection of an appropriate unit operation, from the list of operations disclosed in Bottcher et al., for each of the first and second flow paths of the device, on the basis of suitability for the intended use of the process, would have been routine for one having ordinary skill in the art.

Claims 87-93

13. Claims 87-90, 92 and 93 are rejected under 35 U.S.C. 102(b) as being anticipated by Bottcher et al. (US 5,657,818).

Regarding claims 87 and 93, Bottcher et al. (see FIGs. 1-5; column 1, line 50 to column 2, line 49) discloses a process of making a device (i.e., a permeable structure) for conducting a unit operation comprising:

stacking a plurality of shims (i.e., sheets **2**) such that a continuous flow path is formed through the shims (e.g., continuous channels **1**, formed by aligned openings **7**); wherein the flow path **1** extends in a direction substantially parallel to shim **2** thickness (see FIGs. 1, 2); wherein, as best understood, the flow path **1** in at least one of the shims **2** further comprises a section in which the flow path extends in a direction substantially perpendicular to shim thickness (e.g., the openings **7** that define the flow paths **1** are shaped in a linear or oblong fashion, and therefore, the openings define a flow path that extends in a direction substantially perpendicular to the shim thickness; see, e.g., FIGs. 1, 2, 5; also, see, e.g., column 2, lines 9-16); wherein the plurality of shims comprises at least three, or at least five, adjacent shims **2** (see column 1, lines 31-35) through which the flow path **1** is formed and wherein a straight, unobstructed line is present through the flow path **1** in said at least three shims **2** (see, e.g., FIGs. 1, 2); wherein the flow path **1** in said at least three shims does not mix with any other flow paths (see, e.g., FIGs. 1, 2, wherein the flow paths **1** run linear and parallel to one another); wherein the three shims are configured such that a unit operation can be performed on a fluid in the flow path in which the straight, unobstructed line is present in said at least three adjacent shims (e.g.,

heat exchanging, condensing, reacting, etc.; see column 2, lines 49-55); and bonding the shims to form the device capable of performing the unit operation on a fluid (see column 2, lines 32-36).

Regarding claim 88, Bottcher et al. discloses that the flow path **1** may be configured such that it does not connect with any other flow paths (see, e.g., FIGs. 1, 2, wherein the flow paths **1** are separate from one another, and pass from a corresponding opening **9** in the top cover plate **5** to a corresponding opening **9** in the bottom cover plate **5**).

Regarding claim 89, Bottcher et al. discloses that the section in which the flow path extends in a direction substantially perpendicular to the shim **2** thickness may comprise a header, wherein the header connects to plural flow paths **1** that extend in a direction substantially parallel to the shim thickness (see, e.g., column 2, lines 9-16).

Regarding claim 90, Bottcher et al. discloses that the section in which the flow path **1** extends in a direction substantially perpendicular to the shim **2** thickness comprises a connection to an inlet or outlet (i.e., a connection to inlet/outlet openings **9** in the cover plates **5**; FIGs. 1, 2).

Regarding claim 92, Bottcher et al., as best understood, discloses that the flow path 1 that is in the section in which the flow path extends in a direction substantially perpendicular to the shim thickness also connects to a second section comprising at least three adjacent shims through which the flow path is formed and wherein a straight, unobstructed line is present through the flow path in said at least three shims (see, e.g., column 2, lines 9-16).

14. Claim 91 is rejected under 35 U.S.C. 103(a) as being unpatentable over Bottcher et al. (US 5,657,818) in view of Symonds (WO 01/35043).

Bottcher et al. discloses that the device may be used for performing various unit

operations, including heat exchanging and reacting, etc. (see column 2, lines 49-55). Bottcher et al., however, is silent as to the provision of a catalyst or sorbent within the flow path. In any event, it would have been obvious for one of ordinary skill in the art at the time the invention was made to provide, for instance, a catalyst within the continuous flow path in the process of Bottcher et al., because the provision of catalyst for enabling a chemical reaction within a heat exchanging device would have been considered conventional in the art, as evidenced by Symonds (i.e., the configuration of a heat exchanging device as packed bed catalytic reactor; see page 1, second paragraph; page 4, second to last paragraph; claim 26).

Response to Arguments

15. Applicant's arguments filed November 19, 2007 have been fully considered but they are not persuasive.

Comments regarding the rejection of claims 13-17, 21, 76, 85, 96, 99 and 100 under 35 U.S.C. 102(b) or 103(a) as being anticipated by or obvious over Bottcher et al. (US 5,657,818).

Applicant (at page 18, second to last paragraph) argues,

> "Claim 13 is now amended to incorporate all the limitations of claim 14, specifically, that the unit operation comprises chemical separation or distillation. Bottcher et al., at col. 2, lines 49-54 does not teach or suggest either of these unit operations."

The Examiner respectfully disagrees. Distillation is defined as the volatilization or evaporation and subsequent condensation of a liquid, as when water is boiled in a retort and the steam is condensed in a cool receiver (i.e., the term "distillation" was entered at www.dictionary.com). Bottcher et al. discloses that the device may be used as "heat exchangers, condensers, part-condensers, coolers, reactors, heat exchangers for heaters, especially condensing heaters and waste heat boilers for heat exchange in gas/gas, gas/liquid or liquid/liquid systems, and for

burner designs with gaseous or liquid fuels." (see column 2, lines 50-55). Because the device is disclosed as having specific utility for the volatilization or evaporation of a liquid and condensation of a liquid (e.g., as a boiler, condenser, part-condenser, or condensing heater), it would have been obvious for one of ordinary skill in the art at the time the invention was made to perform the unit operation of distilling using the device of Bottcher et al.

Comments regarding the rejection of claims 87-90, 92 and 93 under 35 U.S.C. 102(b) as being anticipated by Bottcher et al. (US 5,657,818).

Applicant (at page 18, last paragraph) further argues,

> "Claim 87 recites a process in which "the flow path in at least one of the shims further comprises a section in which the flow path extends in a direction substantially perpendicular to shim thickness." Thus, the claimed process utilizes a semi-ortho design in which flow in a flow path runs perpendicular to thickness and parallel to thickness. This is not taught or suggested by Bottcher et al. In Bottcher, flow is either all substantially parallel (channels 1, see col. 1, lines 60-62) or substantially parallel (flow spaces 4)."

The Examiner respectfully disagrees. In the Bottcher et al. device, the flow path **1** in at least one of the shims **2** further comprises a section in which the flow path extends in a direction substantially perpendicular to shim thickness, since the openings **7** that define the flow paths **1** are shaped in a linear or oblong fashion, and therefore, the openings define a flow path that extends in a direction substantially perpendicular to the shim thickness (see, e.g., FIGs. 1, 2, 5; also, see, e.g., column 2, lines 9-16).

Comments regarding the rejection of claims 1-3, 6-9, 75, 78, 79, 86 and 95 under 35 U.S.C. 103(a) as being unpatentable over Bottcher et al. (US 5,657,818) in view of Yamashita (JP 2000-329490).

Applicant (on page 19, second to past paragraph) argues,

> "In Bottcher, heat exchange is enhanced by turbulent flow in the cross-flow channels 4. Thus, the person skilled in the art would not be motivated to modify Bottcher's devices by incorporating the features of Yamashita. Additionally, claim 1, as now amended, recites a second flow path parallel to sheet thickness; this feature is not taught or suggested by Bottcher or the combination of Bottcher and Yamashita."

The Examiner respectfully disagrees. One having ordinary skill in the art would have been motivated to configured the apertures **7** in the device used in the process of Bottcher et al. with a circumference at least 20% populated by edge features, because the edge features would increase the surface area of the continuous flow path, and thereby increase the heat transfer within the device, as taught by Yamashita et al. (see, e.g., section [0012]).

Applicant further argues that claim 1, as amended, recites "a second flow path parallel to sheet thickness". However, it is noted that the argued feature has not been recited in claim 1. Additionally, it is noted that Bottcher et al. further discloses a second flow path parallel to the sheet thickness (e.g., within the second flow path **4**, see FIG. 2).

Applicant (on page 19, last paragraph) further argues,

> "Claim 75 is additionally patentable because it recites that the shape of the aperture comprises waves or irregular shapes. This is not a mere arbitrary shape change; it provides an advantage that is not recognized in the prior art. Specifically, the wavy (see Fig. 4c) or irregular apertures create a boundary layer separation and improve heat transfer."

The Examiner respectfully disagrees. Bottcher et al. discloses that the flow path **1** is formed by an aperture **7** in each of the at least three adjacent shims **2**, wherein the shape may comprise an irregular shape (see, e.g., holes **7a** in FIG. 3).

Comments regarding the rejection of claim 4 under 35 U.S.C. 103(a) as being unpatentable over Bottcher et al. (US 5,657,818) in view of Yamashita (JP 2000-329490), as applied to claim 1 above, and further in view of Bottcher et al. (US 5,212,004).

Applicant (on page 20) further argues,

> "… there is not a proper motivation for combining the design of the '004 patent with the design of the '818 patent."

The Examiner respectfully disagrees. As indicated above, one having ordinary skill in the art would have been motivated to configure the at least three adjacent shims to be identical in the process of Bottcher '818, to allow for the surface ratio of the various flow paths to be varied and thus adapted to meet a particular heat transfer requirement, as taught by Bottcher '004.

Comments regarding the rejection of claims 18-20 and 22 under 35 U.S.C. 103(a) as being unpatentable over Bottcher et al. (US 5,657,818) in view of Bottcher et al. (US 5,212,004).

Applicant (at page 20, last paragraph) argues,

> "This rejection is traversed for the reasons discussed above for claim 13. Additionally, all of these claims depend from claim 16, and claim 16 is now amended to recite adjacent "ortho" style channels comprising a second fluid. Bottcher does not teach or suggest this feature since Bottcher is cross-flow."

The Examiner respectfully disagrees. Claim 16 recites that "the second flow path is substantially parallel to shim thickness." Bottcher et al. '818 discloses this feature. As shown in FIG. 2, for example, the second flow path **4** extends in a direction that is substantially parallel to the shim thickness, since the bridges **6** are arranged such that the fluid may flow parallel to the shim thickness within the stack of shims.

Comments regarding the rejection of claims 24-26, 77 and 97 under 35 U.S.C. 103(a) as being unpatentable over Bottcher et al. (US 5,657,818) in view of Haswell et al. (Article: *Chemical and biochemical microreactors*).

Applicant (beginning with the last paragraph on page 21) argues,

> "… Prior microchannel devices (such as those of Haswell) were oriented such that the microchannels ran along the length of the shim (or plate)... No one had thought to make process microchannels in the direction parallel to shim thickness. Furthermore, no one had recognized any advantage from this orientation, for example, no one had recognized any advantage for constraining high interstream pressure differentials within microchannels using this configuration.
>
> The invention of claim 24 is not obvious over the prior art because the prior art does not provide a motivation to construct microchannel devices in the "ortho" direction; nor does the prior art provide an enabling teaching for microchannels constructed in this fashion… the prior art does not suggest the desirability of microchannel devices constructed in the "ortho" direction, nor does it provide an enabling description for ways to construct such devices..."

The Examiner respectfully disagrees. The argued "ortho" designed device is disclosed in the primary reference to Bottcher et al. The secondary reference to Haswell et al. was merely relied upon for its teaching that microchannel dimensions enable rapid mass and heat transfer to be achieved within the device, thereby providing a higher level of reaction control and reaction manipulation (see page 389, column 2).

Applicant (at page 22, third to last paragraph) further argues,

> "Even if the claimed invention were prima facie obvious, the surprising and superior results for operation at high pressure would establish the nonobviousness of the claimed invention.
>
> Furthermore, the Bottcher reference is not appropriate for an obviousness-type

> rejection because it is non-analogous art. Microchannel devices have special advantages and challenges that set them apart from conventionally sized devices. Microchannel processing is a subspecialty for chemical engineers. The skilled worker would study the microchannel art for ideas for designing a microchannel device. The skilled worker would not look to conventional designs since both the manufacture and expected performance would be expected to be radically different..."

The Examiner respectfully disagrees. One having ordinary skill in the art would have expected the monolithic design of the Bottcher et al. device, e.g., with its bonded/laminated sheets of green ceramic or metal (see column 1, lines 7-10; column 2, lines 33-49), to be inherently capable of withstanding high pressure, absent a showing otherwise. Furthermore, both Bottcher et al. and Haswell et al. would have been considered analogous art, since both references are reasonably concerned with the same problem of achieving improved control of heat transfer (see Bottcher et al: column 1, lines 11-41 and column 2, lines 50-55; see Haswell et al., page 389, column 2, last paragraph). Also, like Bottcher et al., Haswell et al. discusses the production of devices from laminated metal sheets (see page 390, section 2).

Allowable Subject Matter

16. Claims 5 and 98 contain allowable subject matter. The prior art does not disclose or adequately suggest the instantly claimed process comprising forming of the device, wherein a first catalyst or sorbent is placed in the first flow path and a second catalyst is placed in the second flow path, the second catalyst being different than the first catalyst or sorbent.

17. The previously indicated allowability of claim 30 is withdrawn, since Applicant has amended to claims such that the subject matter is no longer considered allowable (i.e., the claims are amended such that an exothermic reaction is no longer conducted in the first flow path).

18. Claims 80 and 81 would be allowable if rewritten to overcome the rejection(s) under 35 U.S.C. 112, 2nd paragraph, set forth in this Office action and to include all of the limitations of the base claim and any intervening claims. The prior art does not disclose or adequately suggest the instantly claimed process comprising the forming of the device and the performing of a unit operation within the flow paths of the device, wherein the unit operation comprises at least two different unit operations using catalysts placed in both the flow path and the second flow path, respectively, wherein the catalysts within each flow path are different.

19. Claims 82 and 83 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. The prior art does not disclose or adequately suggest the claimed process wherein the first unit operation in the first flow path is selected from the group consisting of distilling, adsorbing, separating, absorbing, and combinations thereof (see claim 27), and the first flow path further comprises a metal film.

20. Claim 84 would be allowable if rewritten to overcome the claim objection set forth in this Office action and to include all of the limitations of the base claim and any intervening claims. The prior art does not disclose or adequately suggest the claimed process wherein the second flow path comprises a catalyst metal on an oxide support for conducting a second unit operation of reacting, wherein the first unit operation conducted in the first flow path is selected from the group consisting of distilling, adsorbing, separating, absorbing, and combinations thereof.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to JENNIFER A. LEUNG whose telephone number is (571)272-

1449. The examiner can normally be reached on 9:30 am - 5:30 pm Monday through Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Glenn A. Caldarola can be reached on (571) 272-1444. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Jennifer A. Leung/
Primary Examiner, Art Unit 1797